

- (63) VETERANS ADMINISTRATION COOPERATIVE STUDY GROUP ON ANTIHYPERTENSIVE AGENTS. Effects of treatment on morbidity in hypertension. II. Results in patients with diastolic blood pressure averaging 90 through 114 mm Hg. *Journal of the American Medical Association* 213(7): 1143-1152, August 17, 1970.
- (64) WERKO, L. Prevention of heart attacks. A multifactorial preventive trial in Gothenburg, Sweden. *Annals of Clinical Research* 11(2): 71-79, April 1979.
- (65) WILHELMSSEN, L. Risk factors for disease according to population studies in Gothenburg, Sweden. Paper presented at Skandia International Symposia, September 23-25, 1980. In: Bostrom, H., Ljungstedt, H. (Editors). *Medical Aspects of Mortality Statistics*. Stockholm, Almquist and Wiksell International, 1981, pp. 73-88.
- (66) WILHELMSSEN, L., TIBBLIN, G., WERKO, L. A primary preventive study in Gothenburg, Sweden. *Preventive Medicine* 1: 153-160, March 1972.
- (67) WOLFF, F.W., LINDEMAN, R.D. Effects of treatment in hypertension. Results of a controlled study. *Journal of Chronic Diseases* 19: 227-240, March 1966.
- (68) WORLD HEALTH ORGANIZATION EUROPEAN COLLABORATIVE GROUP. Multifactorial trial in the prevention of coronary heart disease: 2. Risk factor changes at two and four years. *European Heart Journal* 3(2): 184-190, April 1982.
- (69) WORLD HEALTH ORGANIZATION EUROPEAN COLLABORATIVE GROUP. Multifactorial trial in the prevention of coronary heart disease. 3. Incidence and mortality results. *European Heart Journal*, in press.
- (70) WORLD HEALTH ORGANIZATION EXPERT COMMITTEE. Prevention of coronary heart disease. *World Health Organization Technical Report Series*, Number 678, Geneva 1982, 53 pp.

**APPENDIX A: TRENDS IN  
CARDIOVASCULAR  
DISEASES**

## Introduction and Overview

### Mortality Trends

The cardiovascular diseases—primarily heart, cerebrovascular, hypertensive, and peripheral vascular diseases—are widely prevalent in our society and cause substantial illness and death. With the increasing control of infectious and parasitic diseases, especially during the first half of the 20th century, life expectancy has improved and the major cardiovascular diseases as a group have become the underlying cause of approximately 50 percent of all deaths in the United States. They are responsible for more than 950,000 deaths each year (Table 1) (16, 27). The economic cost of heart disease alone was estimated in 1977 to be at least \$40 billion annually (34), and heart disease is ranked first among causes for utilization of acute care hospitals (31). About 21 percent of these cardiovascular deaths occur prior to age 65; 45 percent occur prior to age 75. Until recently, as the Nation's population became proportionately older, the crude death rate for the cardiovascular diseases had increased to a plateau. In contrast, the age-adjusted death rate, stable until 1940, has since declined (2, 17, 19, 27, 40, 41). During the 1960s, the downward trend in the age-adjusted rate steepened markedly. Almost two-thirds of the decline between 1950 and 1978 occurred after 1968, a 27 percent decline (Figure 1; Table 2) (1, 18, 22, 23, 24, 27, 30). Death rates for most cardiovascular diseases declined over the entire period from 1950 to 1978, except for the major subgroup of coronary heart disease (CHD), for which there was a consistent rise in mortality in the 1950s and 1960s, followed by a dramatic decline (Figure 2) (2, 25, 27). The age-adjusted death rate for all cardiovascular diseases combined was lower by 63 deaths per 100,000 population in 1967 than in 1950. This decrease reflected declines for cerebrovascular and hypertensive diseases that counteracted the increase of 27 deaths per 100,000 population for coronary heart disease. In the more recent period, 1968 to 1978, the death rate for all cardiovascular diseases declined by 100 deaths per 100,000 population, with declines for CHD and cerebrovascular diseases accounting for almost all of the decline. The reversal in mortality from CHD during 1968–1978 was real, although partly attributable to the shift in classification of deaths that brought more hypertensive disease deaths into the CHD classification (see the Technical Notes at the end of this appendix). It was accompanied by an acceleration in the rate of decline for mortality from the cerebrovascular diseases and a continuation of the percentage declines for other subgroups of cardiovascular diseases.

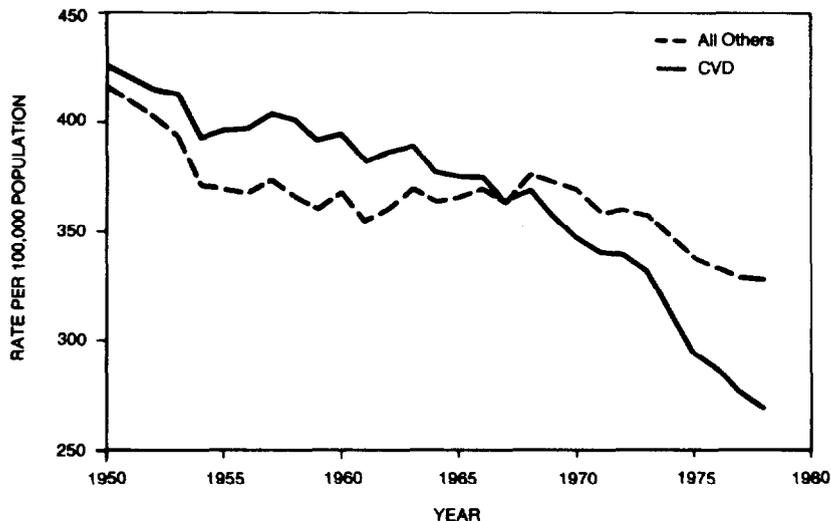
The decline in deaths from cardiovascular diseases since 1968 was striking in comparison with the trends for other causes of death. As Figure 1 and Table 2 show, the decline since 1968 for all noncardio-

**TABLE 1.—Number of deaths from all causes and from the major cardiovascular diseases by age, United States, 1979**

Causes of death <sup>1</sup> (terminology used in this report)	Total	Under 25	25-34	35-44	45-54	55-64	65-74	75-84	85 and over	Age not stated
All causes	1,913,841	113,638	47,941	57,723	135,265	286,966	449,255	493,676	328,725	652
Major cardiovascular diseases (390-488)	958,282	3,214	4,209	14,108	49,830	126,410	230,308	300,520	229,510	173
Coronary heart disease (410-414)	551,365	191	1,289	3,568	31,211	81,722	142,119	169,062	118,112	91
Acute myocardial infarction (410)	300,462	115	877	5,310	21,694	55,524	88,526	86,262	42,102	42
Other coronary heart disease (411-414)	250,903	76	412	2,258	9,517	26,198	53,593	82,800	76,010	49
Cerebrovascular diseases (430-438)	169,488	679	947	2,277	6,061	14,610	34,807	60,324	49,760	23
Hypertensive diseases (401-405)	31,916	47	210	679	2,102	4,643	7,849	9,567	6,803	16
Diseases of arterioles, capillaries (440-448)	48,284	146	173	302	1,028	3,884	9,888	15,671	17,186	6
Atherosclerosis (440)	28,801	4	5	37	208	1,023	3,736	9,525	14,260	3
Aortic aneurysm (441)	14,031	43	70	127	464	1,968	4,701	4,713	1,937	2
Other (442-448)	5,452	99	98	138	356	893	1,451	1,433	989	1
All other cardio- vascular (residual)	157,229	2,151	1,590	3,282	9,428	21,551	35,645	45,896	37,649	37
All other causes of death (residual)	955,559	110,424	43,732	43,615	85,435	160,556	218,947	193,156	99,215	479

<sup>1</sup> Coded to the *International Classification of Diseases, Ninth Revision, World Health Organization (45)*.

SOURCE: National Center for Health Statistics (27).



**FIGURE 1.—Age-adjusted\* death rates for cardiovascular diseases and all other causes of death, United States, 1950–1978**

\* Rates are age-adjusted to the 1940 U.S. population distribution.  
 SOURCE: National Center for Health Statistics (25, 27), Bureau of the Census (2).

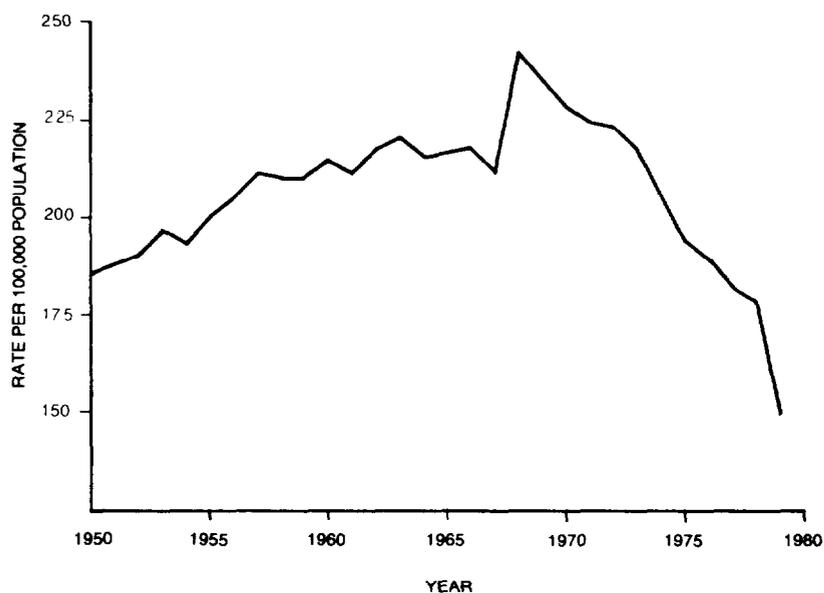
vascular causes of death combined was only 13 percent. The decline in all cardiovascular disease deaths since 1963 translates into 289,000 fewer deaths in 1980 than would have occurred had the death rate remained at its 1970 level. The large decline for CHD alone translates into 237,000 fewer deaths in 1980 than would have occurred if the rate had remained at its peak (1963) level (see the Technical Notes at the end of this appendix). The decline in cardiovascular disease mortality, therefore, represents a major contribution to reduced total mortality and improved average life expectancy (Table 2; Figure 3) (19, 29).

Percentage declines were particularly steep for younger adults, for women, and for the nonwhite population, but were substantial for all demographic groups, including the elderly (Table 3). There are some geographic differences in U.S. cardiovascular mortality trends, but all areas have experienced substantial declines (13). Moreover, the United States differs from other countries in this decline, for in most countries the death rate continues to increase, especially for CHD among middle-aged men (Figure 4) (46).

**TABLE 2.—Changes in the age-adjusted death rate for all causes, cardiovascular diseases, and all other causes of death, United States, 1950–1967 and 1968–1978**

Cause of death	1950–1967		1968–1978	
	Change in rate per 100,000 pop.	Percent change	Change in rate per 100,000 pop.	Percent change
All causes	-115.9*	-13.8	-148.8	-20.0
Total cardiovascular	-63.0	-14.8	-100.4	-27.3
Coronary heart disease	+26.6	+14.4	-64.1	-26.5
Cerebrovascular diseases	-19.1	-21.5	-26.9	-37.7
Hypertensive diseases	-33.8	60.4	-5.1	-54.3
Other arteriosclerosis	-5.1	-53.6	-3.7	-38.5
Rheumatic heart disease	-7.5	-31.5	-2.8	-38.9
Other cardiovascular diseases	-24.1	-36.8	+2.2	+7.5
All other causes of death	-52.9	-12.7	-48.4	-12.9

SOURCE: Bureau of the Census (1), National Center for Health Statistics (18, 22, 23, 25, 27, 30).



**FIGURE 2.—Age-adjusted\* death rates for coronary heart disease, United States, 1950-1978**

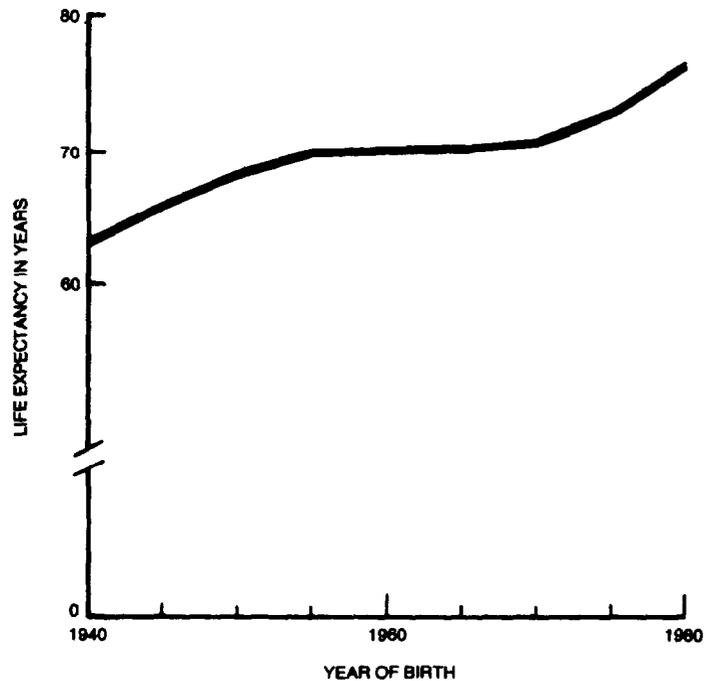
\* Rates are age-adjusted to the 1940 U.S. population distribution.  
 SOURCE: National Center for Health Statistics (26, 27), Bureau of the Census (2).

**Methodological Considerations**

Measurement of trends in death rates from 1950 to 1979 has been affected by (1) revisions of the International Classification of Disease in 1958, 1968, and 1979, (2) revisions of population estimates following census counts in 1960, 1970, and 1980, and (3) the major influenza epidemics in 1957, 1963, and 1968, which were years of unusually high mortality. The Technical Notes that appear at the end of this appendix discuss the International Classification of Diseases codes and explains certain adjustments, limitations, and other points of methodology of these statistics.

**Cardiovascular and Noncardiovascular Mortality**

The recent decline in cardiovascular mortality has not been unique. Between 1968 and 1978, the period during which the eighth revision of the International Classification of Diseases was in use, the age-adjusted death rate in the United States declined for all major causes of death except lung cancer and chronic obstructive pulmonary disease (COPD), i.e., emphysema and chronic bronchitis



**FIGURE 3.—Life expectancy at birth, United States, 1940–1980**

SOURCE: National Center for Health Statistics (19, 29).

(Table 4). Excluding these two causes, mortality from the other causes of death declined a total of 160 deaths per 100,000 population. The percentage declines in mortality apply to both middle-aged persons and those 65 years of age or older. Although the percentage declines in mortality from diabetes mellitus and influenza or pneumonia exceed those for the cardiovascular diseases, mortality declines for the cardiovascular diseases contributed greatly to the declining overall mortality, accounting for 63 percent overall and 81 percent of the decline in mortality at age 65 and older.

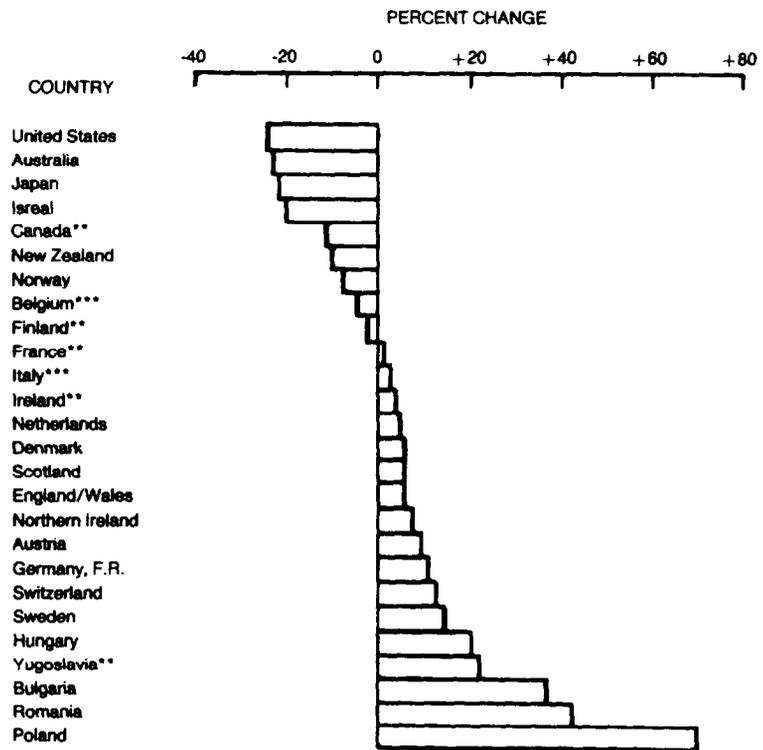
Figure 5 shows that mortality rates from influenza, pneumonia, and diabetes mellitus have declined since the late 1960s. After a long-term increase, mortality from cirrhosis of the liver has declined since about 1975. Thus, the decline in cardiovascular disease mortality is not unique, but is notable for the magnitude of the decline in terms of reduced numbers of deaths and the acceleration in the declining mortality from stroke. The percentage decline in the death rates from coronary heart disease between 1969 and 1978 were

**TABLE 3.—Percent changes in death rates<sup>1</sup> for selected causes of death by sex, color, and selected age groups, United States, 1968–1978**

Color, sex, age	All causes	Cardiovascular diseases (390–458)				All other causes of death
		Total	Coronary heart diseases (410–413)	Cerebrovascular diseases (430–438)	Other cardiovascular diseases	
<b>Both sexes<sup>1</sup></b>	-20.0	-27.3	-26.5	-37.7	-16.9	-12.9
25–34	-16.2	-38.8	-37.5	-46.9	-35.2	-12.9
35–44	-25.4	-35.7	-36.9	-40.6	-29.6	-21.0
45–54	-18.8	-27.2	-26.7	-38.6	-20.0	-12.6
55–64	-18.6	-27.8	-27.8	-40.3	-15.1	-9.3
65–74	-19.0	-28.1	-27.8	-40.7	-11.6	-5.9
75–84	-19.1	-25.9	-24.4	-35.5	-16.3	-4.8
85+	-21.0	-24.7	-21.1	-33.4	-24.5	-10.1
<b>White males<sup>1</sup></b>	-17.7	-24.7	-24.5	-37.5	-11.1	-10.3
25–34	-7.5	-34.5	-31.7	-44.4	-24.2	-4.6
35–44	-22.9	-33.9	-36.4	-37.5	-19.4	-17.2
45–54	-19.4	-26.5	-27.0	-41.2	-13.4	-12.7
55–64	-19.9	-26.4	-27.0	-41.0	-10.4	-12.4
65–74	-17.1	-25.0	-24.9	-40.0	-6.3	-5.8
75–84	-13.4	-21.8	-20.0	-34.8	-9.9	+2.5
85+	-16.9	-22.9	-18.7	-34.7	-21.8	-1.9
<b>White females<sup>1</sup></b>	-20.4	-28.3	-27.3	-36.2	-20.7	-12.7
25–34	-18.5	-38.5	-40.9	-41.7	-35.6	-15.2
35–44	-25.8	-34.1	-35.6	-34.4	-32.2	-23.4
45–54	-16.5	-27.2	-25.1	-32.9	-26.4	-12.0
55–64	-13.5	-27.3	-27.4	-35.0	-18.9	-2.9
65–74	-20.0	-30.7	-31.1	-40.3	-14.0	-4.4
75–84	-22.1	-27.7	-26.0	-35.9	-20.2	-8.9
85+	-23.2	-25.9	-22.2	-33.6	-26.9	-14.2
<b>Nonwhite males<sup>1</sup></b>	-21.1	-27.1	-24.1	-40.0	-20.8	-16.7
25–34	-30.3	-43.1	-40.6	-52.1	-39.1	-28.5
35–44	-28.9	-38.2	-37.3	-44.8	-35.4	-25.0
45–54	-20.4	-27.2	-24.4	-41.6	-21.5	-15.6
55–64	-18.3	-28.0	-24.4	-44.8	-20.1	-8.5
65–74	-18.4	-28.4	-25.2	-40.8	-20.7	-5.1
75–84	-13.2	-21.7	-18.6	-33.5	-11.5	-0.1
85+	-7.4	-15.7	-14.5	-26.6	-3.8	+8.8
<b>Nonwhite females<sup>1</sup></b>	-29.7	-36.0	-33.7	-45.9	-28.3	-23.8
25–34	-41.9	-58.1	-65.7	-58.4	-55.0	-37.4
35–44	-42.5	-53.9	-53.5	-60.9	-48.1	-36.8
45–54	-31.5	-42.3	-38.1	-52.4	-39.7	-23.1
55–64	-29.6	-40.0	-39.1	-51.4	-25.3	-17.7
65–74	-27.2	-36.1	-33.9	-47.7	-23.4	-11.6
75–84	-19.7	-26.6	-25.4	-34.4	-16.4	-3.9
85+	-13.3	-17.0	-13.9	-25.9	-12.6	-3.9

<sup>1</sup> Age-adjusted.

SOURCE: National Center for Health Statistics (27); Bureau of the Census (2).



**FIGURE 4.—Percent of change in the death rate for coronary heart disease in males, ages 35–74, by country, 1969–1978\***

\* Age-averaged rates.

\*\* 1969–1977.

\*\*\* 1969–1976.

SOURCE: World Health Organization (46).

similar for the United States, Australia, Japan, and Israel (Figure 4). These percentage declines in coronary heart disease mortality among middle-aged men were at least twice the percentage decline for the noncardiovascular causes of death. The same was true for women. Elsewhere in the world, cardiovascular mortality did not decline; its percentage change was not much different from changes for the noncardiovascular causes of death as a group (46).

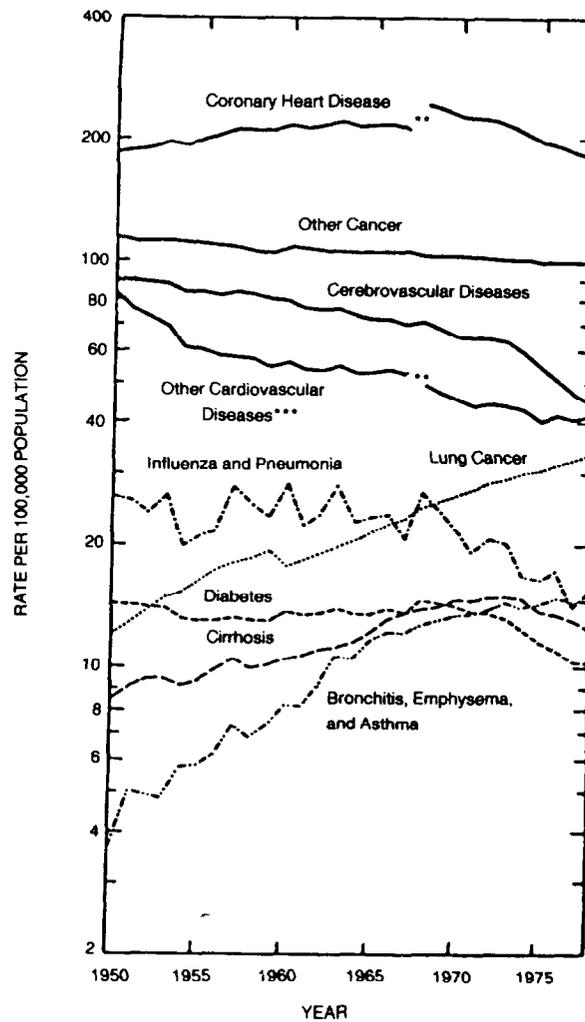
### Smoking-Related Diseases

The substantial declines in cardiovascular mortality trends are a long-term pattern that can be correlated to trends in cigarette smoking in men. Before the 1950s, total mortality in the United

**TABLE 4.—Change in age-adjusted death rates for all ages and two age groups by cause of death,  
United States, 1968–1978**

Cause of death	All ages				Ages 25–64				Ages 65+			
	Rate/100,000 1968	1978	Change	Percent change	Rate/100,000 1968	1978	Change	Percent change	Rate/100,000 1968	1978	Change	Percent change
All causes	743.8	595.0	-148.8	-20.0	591.4	476.3	-115.1	-19.5	5,519.6	4,453.0	-1,066.6	-19.3
Coronary heart disease	241.6	177.5	-64.1	-26.5	168.5	120.6	-47.9	-28.4	2,297.4	1,711.6	-585.8	-25.5
Cerebrovascular diseases	71.3	44.4	-26.9	-37.7	36.3	21.7	-14.6	-40.2	768.4	483.3	-285.1	-37.1
Other cardiovascular	55.5	46.1	-9.4	-16.9	41.0	32.8	-8.2	-20.0	493.4	414.7	-78.7	-16.0
Lung cancer	24.9	33.2	+8.3	+33.3	29.0	37.0	+8.0	+27.6	152.3	214.4	+62.1	+40.8
Other cancer	104.3	98.4	-5.9	-5.6	103.3	94.4	-8.9	-8.6	723.4	716.4	-7.0	-1.0
COPD	11.6	14.5	+2.9	+25.0	8.8	9.1	+0.3	+3.4	103.2	143.6	+40.4	+39.1
Influenza and pneumonia	26.9	15.1	-11.8	-43.9	15.3	8.0	-7.3	-47.7	205.7	143.8	-61.9	-30.1
Diabetes mellitus	14.6	10.2	-4.4	-30.1	11.6	8.1	-3.5	-30.2	126.0	88.7	-37.3	-29.6
Cirrhosis of the liver	13.9	12.4	-1.5	-10.8	22.5	19.6	-2.9	-12.9	36.9	37.3	+0.4	+1.1
Accidents, poisonings, and violence	76.5	66.7	-9.8	-12.8	84.7	73.6	-11.1	-13.1	158.6	111.2	-47.4	-29.9
All other causes	102.7	76.5	-26.2	-25.5	70.4	51.4	-19.0	-27.0	454.3	388.0	-66.3	-14.6

SOURCE: National Center for Health Statistics (27), Bureau of the Census (2).



**FIGURE 5.—Age-adjusted\* death rates for the leading causes of death, United States, 1950–1978**

\* Rates are age-adjusted to the 1940 U.S. population distribution.  
 \*\* This break in trend is due to a revision of the International Classification of Diseases. It affects the cardiovascular diseases more than other causes of death.  
 \*\*\* Primarily hypertensive, peripheral, and rheumatic heart disease.  
 SOURCE: National Center for Health Statistics (18, 22, 23, 27, 30), Bureau of the Census (1, 2).

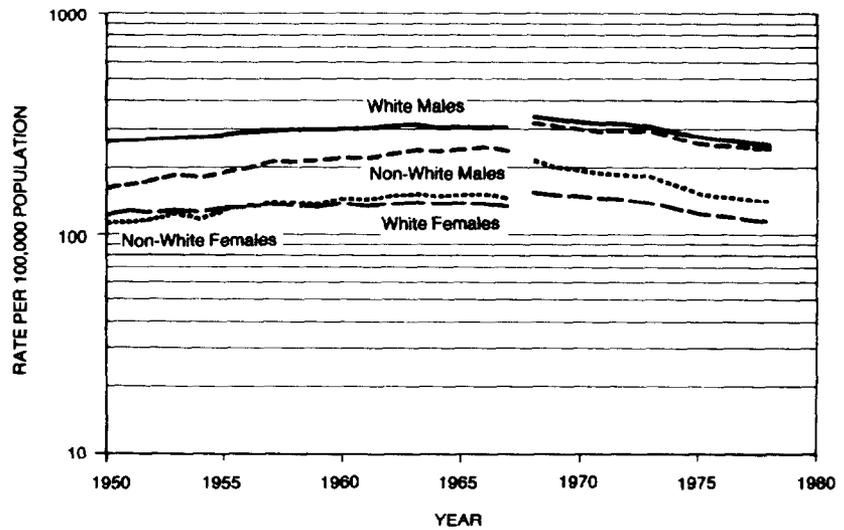
States declined rapidly, as the decreased mortality from infectious and parasitic diseases masked an increasing mortality rate from diseases associated with smoking—especially CHD, lung cancer, and COPD. Between 1955 and 1965, the total mortality decline stopped for men and slowed for women, partly because the numbers of deaths

from the smoking-related diseases of lung cancer, chronic obstructive lung disease, and cardiovascular disease were increasing quite substantially (especially among men), cancelling the gains made in other causes of death. Percentage increases were greater for lung cancer and COPD than for CHD, but compared with rates for CHD, death rates for these two diseases were lower in absolute terms. Since the mid-1960s, the remarkable decline in the coronary death rate has resulted in a new decline in total mortality. Although death rates for lung cancer and COPD are still increasing, the rate of increase is slowing, and in recent years, there is a suggestion of a reversal in lung cancer mortality among the younger cohorts (39).

### **Coronary Heart Disease Mortality**

The age-adjusted death rate for CHD increased 19 percent from 1950 to 1963, peaked in 1963, and then declined 30 percent from 1963 to 1979 (Figure 2). (This assumes good comparability of cause-of-death assignment and classification to CHD for 1963 and 1979. See the Technical Notes at the end of this appendix.) The reversal of the trend was gradual; however, the inflection point was the mid-1960s. During the period between 1968 and 1978, when CHD mortality was classified according to the eighth revision of the International Classification of Diseases, the age-adjusted death rate declined 26.5 percent (Table 3). The decline was greatest at younger ages, ranging from 38 percent for ages 25 to 34 to 21 percent for age 85 and older. Nonwhite females experienced the largest decline of any sex/color group—34 percent, with declines exceeding 50 percent in persons 45 years of age or younger. The mortality trends for CHD displayed in Figure 6 show a striking change from the differential trends among the four sex/color groups prior to 1968 and remarkably similar downward slopes since then. Rates for white and nonwhite females appear to have begun their current decline in about 1964. The earliest that the rates for white and nonwhite males began their current decline was 1967, following a brief plateau. Further, age-specific CHD mortality trends prior to the current decline showed greater differences than during the current decline (Figure 7). As stated above, however, declines continue to be steeper for younger than for older persons. The decline in CHD mortality is substantial in every State in the country, but is less marked in Appalachia, an area of relatively high CHD mortality. There is also some evidence that for life insurance policyholders, constituting a higher socioeconomic group than the general population, declines are steeper than for the general population (15).

A breakdown of CHD deaths into deaths from acute myocardial infarction and deaths from other types of CHD is possible, but it is not known to which group most sudden or out-of-hospital CHD



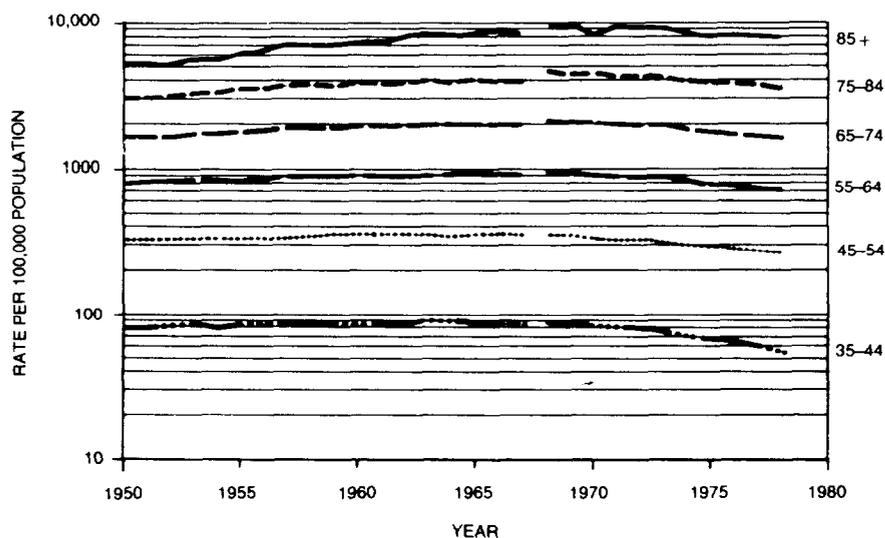
**FIGURE 6.—Age-adjusted\* death rates for coronary heart disease by sex and color, all ages, United States, 1950–1978**

\* Rates are age-adjusted to the 1940 U.S. population distribution.  
 SOURCE: National Center for Health Statistics (25, 27), Bureau of the Census (2).

deaths are classified (Table 1). A much steeper decline in the death rate for acute myocardial infarction than for other CHD occurred during the 1968–1978 period (Figure 8). More information is needed before it can be determined what significance to ascribe to this difference.

#### Other Cardiovascular Disease Mortality

The leading cause of death after heart disease and cancer is stroke, a cerebrovascular disease and a major component of cardiovascular diseases. The underlying process for about 80 percent of all strokes is arteriosclerosis, and hypertension is a major contributing factor (38). However, the age-adjusted death rate for stroke has been declining since before 1930, and has shown an accelerated downward trend in recent years (Figure 9). In the time period 1950–1967, the age-adjusted death rate for cerebrovascular disease declined almost 22 percent; this rate of decline accelerated during the time period 1968–1978 to 38 percent (Table 2). The death rate declined 1.0 percent per year in the 1950s and 1.8 percent per year in the 1960s. As is the case for CHD, the trend for stroke mortality since 1968 has been



**FIGURE 7.—Age-adjusted\* death rates for coronary heart disease by age, white males, United States, 1950–1978**

\* Rates are age-adjusted to the 1940 U.S. population distribution.

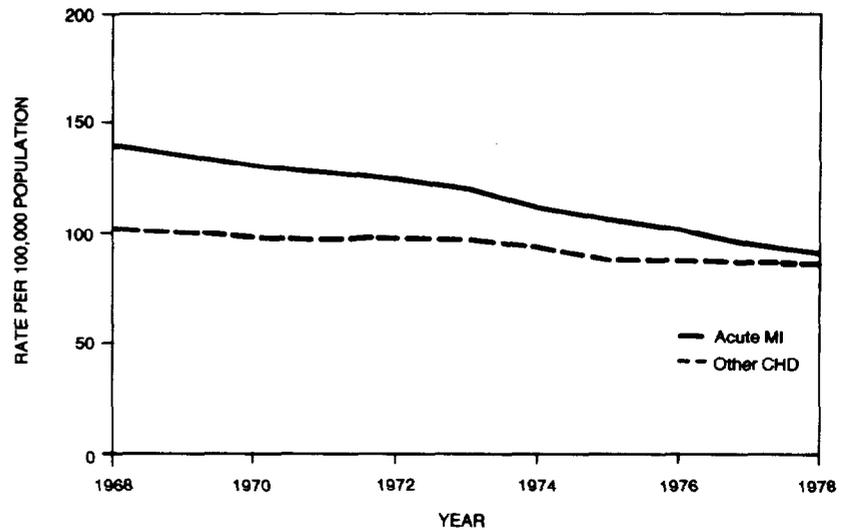
SOURCE: National Center for Health Statistics (25, 27), Bureau of the Census (2).

uniformly downward for the sex/color groups, with declines being especially steep for nonwhites and younger adults (2, 21, 23, 27).

The age-adjusted death rate for hypertensive disease declined an average of 4.9 percent per year in the 1950s, 5.0 percent between 1960 and 1967, and 7.2 percent between 1970 and 1978. Similar to the trend for stroke, there is a steepening of the long-term decline in mortality from hypertensive disease, with recent declines being steeper among nonwhites than among whites. Large declines for the general arteriosclerosis category and for all other cardiovascular diseases combined occurred throughout the 1950–1978 period, including a decline in mortality rates for aortic aneurysm from 1968 to 1978.

### **Incidence and Case-Fatality**

A decline in mortality rates may reflect changes in either the number of new and recurrent coronary attacks (incidence) or the survivorship from such attacks (case-fatality). Reliable national statistics of either incidence or case-fatality are not available. National prevalence and hospital discharge statistics are limited as



**FIGURE 8.—Age-adjusted\* death rates for acute myocardial infarction and other CHD, United States, 1968–1978**

\* Rates are age-adjusted to 1940 U.S. population distribution.

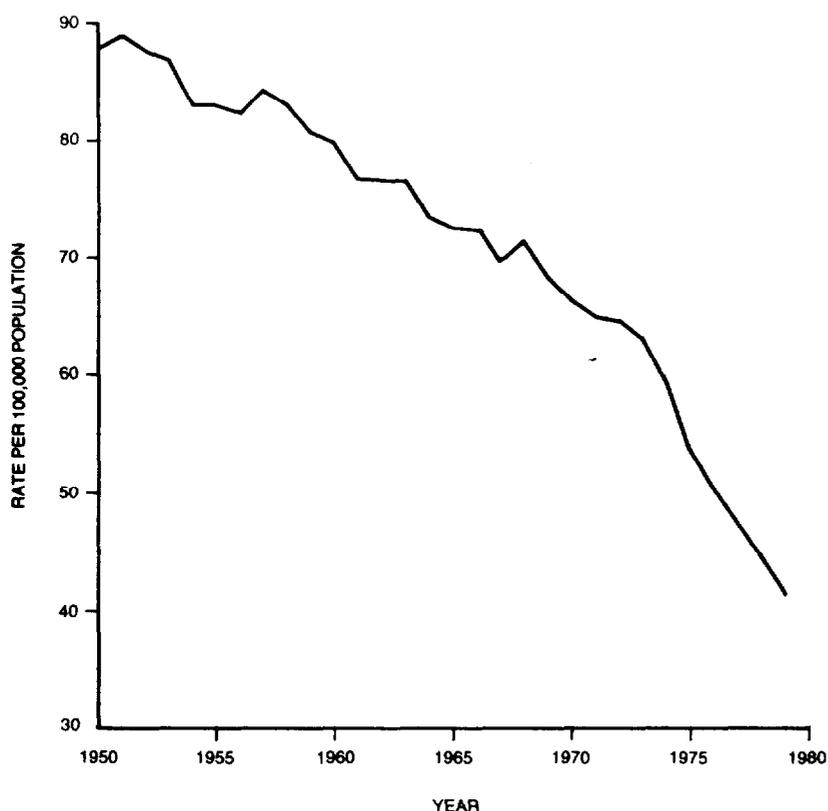
SOURCE: National Center for Health Statistics (27), Bureau of the Census (2).

measures of these trends. Reliance therefore must be placed primarily on available community- or hospital-based studies.

In a study of male employees of the DuPont company in Delaware, the incidence rate of acute myocardial infarction was 18 percent lower in the 1973–1979 period than in the 1957–1964 period (33). Overall 30-day case-fatality rates and the proportion of sudden deaths did not change significantly. However, beginning about 1969, the 30-day mortality among persons who survived 24 hours after the attack declined significantly.

In the Kaiser-Permanente Medical Care Program in the San Francisco area, the proportion of persons hospitalized each year (rate/1,000 subscribers) for acute myocardial infarction declined 27 percent between 1971 and 1977 (5). The proportion of persons hospitalized for any coronary heart disease event declined 18 percent. The decline was seen in both first and recurrent events and did not result from shifting to noncoronary diagnoses. No clear trend could be ascertained in the proportion of persons who died from acute myocardial infarction of all persons hospitalized for this disease each year.

In a study of the population of Rochester, Minnesota, there was no change in the incidence of initial manifestations of coronary heart



**FIGURE 9.—Age-adjusted\* death rates for cerebrovascular diseases, all ages, United States, 1950-1978**

\* Rates are age-adjusted to the 1940 U.S. population distribution.

SOURCE: National Center for Health Statistics (21, 23, 27), Bureau of the Census (2).

disease between 1950 and 1969 (3). However, the case-fatality rate, based on sudden, unexpected deaths and myocardial infarction deaths under 30 days, was 34 percent in the 1970-1975 period, whereas it had been 47 percent in the 1950-1955 period. In contrast, during 1971-1978, males under 65 years of age enrolled in the Health Insurance Plan of Greater New York who had recovered from a first myocardial infarction showed no better survival over 4.5 years than did a comparable group during 1961-1970 (43).

One study provides secular trends on the severity of coronary atherosclerosis between 1960-1964 and 1968-1972 (36). Autopsy findings in this New Orleans study reveal that the extent of intimal surface covered by raised lesions decreased significantly between

1960–1964 and 1968–1972 among white males 25 to 44 years of age, and also decreased slightly among black males.

In the Kaiser-Permanente study, the proportion of persons hospitalized for cerebral thrombosis dropped 64 percent between 1971 and 1977, most of the drop occurring after 1973. The decline for all cerebrovascular diseases combined was 15 percent. In the Rochester, Minnesota, population there was a 45 percent decline in the incidence of stroke between 1945 and 1974, with reductions more pronounced in the elderly (6). The Framingham study observed a lower incidence rate for stroke among women (but not among men) followed since 1962, as compared with women followed since 1950 (10).

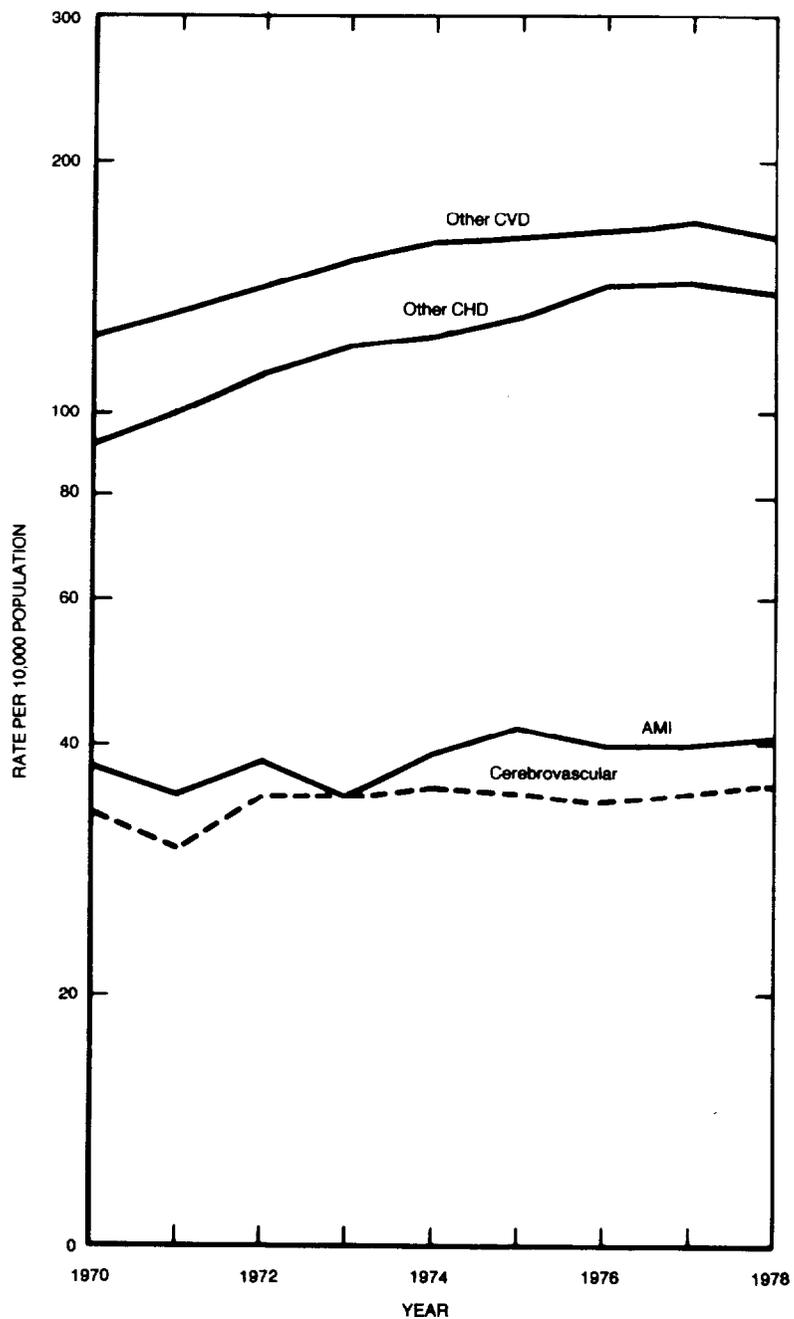
Trends in national hospital discharge statistics from the National Center for Health Statistics are available, but difficult to interpret. Discharge rates for both acute myocardial infarction and stroke between 1970 and 1978 show no increase in incidence of acute events (Figure 10) (26, 37). These data, however, are not inconsistent with a decline in CHD incidence, because patients are increasingly being admitted for cardiac pacemaker insertion and replacement, for catheterizations, and for other diagnostic and therapeutic procedures (Table 5). Figure 11 shows annual data on hospital case-fatality rates. Despite annual fluctuations, the trend in case-fatality rates from 1970 to 1978 is clearly downward for acute myocardial infarction. This could result from an increased tendency to admit milder cases not previously hospitalized, from a real improvement in therapeutic efficacy, or from a mixture of both.

## **Risk Factors and Treatment**

### **Risk Factor Reduction**

As is discussed elsewhere in this Report, three major modifiable risk factors—cigarette smoking, hypertension, and hypercholesterolemia—are statistically significant contributors to cardiovascular risk for both men and women (Table 10) (14). Cigarette smoking, hypertension, and a high serum cholesterol each have been found to increase coronary heart disease risk. The nationwide efforts to reduce cigarette smoking, to control high blood pressure, and to avoid foods high in saturated fats (4) have reduced the levels of these risk factors during the past 15 years (Tables 6, 7, 8, and 9) (24, 28, 32). The reduction in each of the risk factors coincides with the observed decline in CHD mortality.

Attempts have been made to estimate how much of the reduction in cardiovascular disease mortality can be ascribed to observed reductions in risk factor levels (11, 12, 35). Findings have not been definitive because of data limitations. It has not been possible to quantify or to rank the separate contributions of a reduction in any



**FIGURE 10.—Rate of hospital discharges for major components of cardiovascular disease, ages 45–65, United States, 1970–1978**

SOURCE: National Center for Health Statistics (26), Thom et al. (37).

**TABLE 5.—Number of selected cardiovascular surgical procedures, United States, 1970, 1975, 1980**

Procedure	1970	1975	1980
Coronary bypass <sup>1</sup>	14,000	57,000	137,000
Cardiac valves <sup>2</sup>	16,000	23,000	35,000
Catheterizations <sup>3</sup>	77,000	189,000	348,000
Pacemaker insertions <sup>4,5</sup>	24,000	60,000	143,000
All vascular and cardiac <sup>6</sup>	506,000	888,000	1,484,000

<sup>1</sup> ICD/8 codes 29.8; ICD/9 codes 36.1–36.3.

<sup>2</sup> ICD/8 codes 29.2–29.4; ICD/9 codes 35.1,35.2,35.99.

<sup>3</sup> ICD/8 codes 30.2; ICD/9 codes 37.21–37.23.

<sup>4</sup> ICD/8 codes 30.4; ICD/9 codes 37.7.

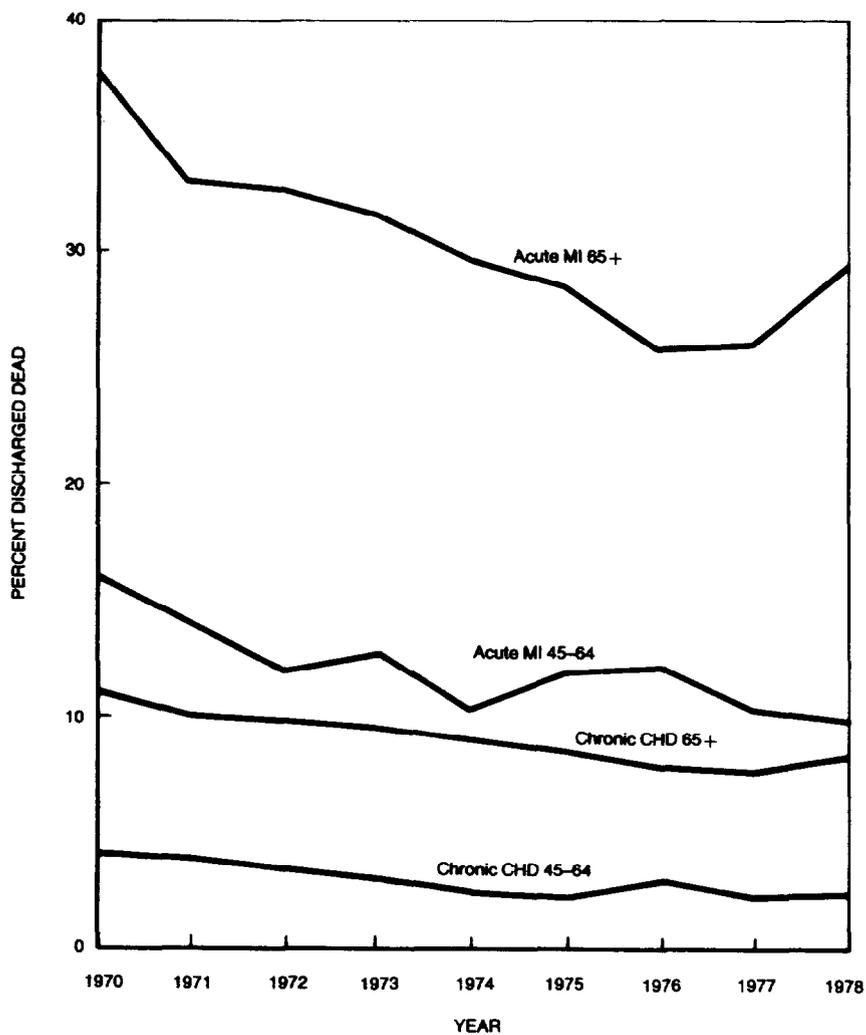
<sup>5</sup> ICD/8 codes 24–30; ICD/9 codes 35.1–40.5.

<sup>6</sup> Excludes replacements.

SOURCE: National Center for Health Statistics (26), Thom (37).

one risk factor to the mortality decline, but one analysis concluded that “elimination of smoking would have the greatest impact on CHD death rates” (11). The extent to which changes in these risk factors may have contributed to the decline in mortality depends, in part, on their prevalence in the U.S. population, and thus, on the reduction in prevalence that has taken place in recent years.

An estimated 38.3 percent of adult men and 29.2 percent of adult women smoke cigarettes, that is, 50 to 55 million persons as of 1980 (Table 6). These percentages represent large declines from the 52.4 percent and 34.1 percent, respectively, in 1965 (28). Table 6 gives the age-adjusted and age-specific rates that correspond to these crude rates of smoking. In a 1976 to 1980 survey, an estimated 22 percent of persons 25 to 74 years of age, about 25 million persons, had hypertension, i.e., a systolic blood pressure of 160 mm Hg or greater, a diastolic blood pressure of 95 mm Hg or greater, or were on antihypertensive medication (Table 8) (32). Although the prevalence rate in 1960–1962 was about the same (20 percent), a much larger proportion of persons with hypertension in the more recent period were aware of it (73 vs. 49 percent), were on treatment for it (56 vs. 31 percent), and had it controlled (34 vs. 16 percent). In a survey in 1971–1974, an estimated 21.9 percent of persons 18 to 74 years of age, 28 million persons, had serum cholesterol levels of 260 mg/100 ml or greater (24). After adjusting these crude rates to make them comparable by age to estimates in the 1960–1962 survey, the percentage of persons at that level or greater was less than in the 1960–1962 survey, although the decline was not statistically significant for all age/sex groups (Table 9). As of 1979, there were about 5 million adults with diabetes mellitus, 3 percent of the adult population (28). There apparently has been no reduction in prevalence in recent years.



**FIGURE 11.—Hospital case-fatality rate for acute myocardial infarction and chronic CHD, United States, 1970–1978**

NOTE: First listed diagnosis on discharge: ICD/8 code 410 for acute MI, and 412 for chronic CHD.  
 SOURCE: National Center for Health Statistics (26), Thom et al. (37).

The correlation of independent risk factors to cardiovascular disease risk is shown in Table 10. The documented changes in risk factors in Tables 6–9 suggest that the decline in the prevalence of cigarette smoking, which affected the greatest number of people, may have contributed more to the decline than did changes in the other risk factors. This assertion depends on the quality of data on

the prevalence of smoking, the changes in prevalence of smoking, and the relative strength of the association between smoking and CHD risk, as well as evidence that cessation of smoking lowers the risk of acute and recurrent myocardial infarction mortality.

### **Impact of Improved Treatment**

Improvements have been made in recent years in the medical care of the coronary patient prior to, during, and after hospitalization. Treatment is now more aggressive and sophisticated, and the improved management techniques are more generally available throughout the country. Today's coronary patient has a much better chance of arriving alive at a hospital and at an earlier stage of the episode than was the case a decade or two ago (7). Once hospitalized, the patient is monitored for arrhythmias and changes in cardiac function, usually in a coronary care unit. Catheterizations and coronary artery bypass surgery have been performed with greatly increased frequency in recent years (Table 5). It is likely that improved treatment in a hospital has reduced the case-fatality rate of these patients (Figure 11). The post-discharge treatment is better managed today. The coronary patient with angina pectoris or hypertension receives more aggressive and effective treatment; antiarrhythmic drug therapies are widely used; and many patients are advised to stop smoking, modify their diet, and lose weight. Although documentation of the occurrence in time of many of these treatment improvements is incomplete, most were made in the 1960s and 1970s.

### **Trends and Associated Factors**

The reversal of the death rate for CHD and the acceleration of the decline for stroke have coincided over time with increased efforts in primary and secondary prevention. These efforts include the anti-smoking campaigns since 1964, the nationwide campaign against hypertension since 1972, a trend away from saturated fats in the diet, and changes in treatment, such as expanded utilization of coronary care units, cardiac surgery, cardiac catheterization, and pacemakers (8). The public is now more aware of cardiovascular risk factors, especially cigarette smoking, hypertension, and elevated serum cholesterol. Also, when a heart attack or stroke occurs, today's patient generally receives more aggressive medical management (7, 9).

### **Trends and Smoking**

The proportion of both cigarette smokers and CHD mortality increased until the mid-1960s and then declined markedly. Tempo-

**TABLE 6.—Percentage distribution of adult current and former cigarette smokers, according to sex, race, and age, in 1965, 1976, and 1980**

Sex, race, and age	Current smoker <sup>1</sup> (percent)			Former smoker (percent)		
	1965	1976	1980 <sup>2</sup>	1965	1976	1980 <sup>2</sup>
<b>MALE</b>						
Total <sup>3,4</sup>						
All ages ≥ 20 <sup>5</sup>	52.1	41.6	37.9	20.3	29.6	30.5
20-24	59.2	45.9	39.7	9.0	12.2	12.1
25-34	60.7	48.5	43.1	14.7	18.3	20.6
35-44	58.2	47.6	42.6	20.6	27.3	27.6
45-64	51.9	41.3	40.8	24.1	37.1	36.9
≥ 65	28.5	23.0	17.9	28.1	44.4	47.4
White						
All ages ≥ 20 <sup>5</sup>	51.3	41.0	37.1	21.2	30.7	31.9
20-24	58.1	45.3	39.0	9.6	13.3	12.2
25-34	60.1	47.7	42.0	15.5	18.9	21.9
35-44	57.3	46.8	42.4	21.5	28.9	28.8
45-64	51.3	40.6	40.0	25.1	38.1	38.4
≥ 65	27.7	22.8	16.6	28.7	45.6	50.1
Black						
All ages ≥ 20 <sup>5</sup>	59.6	50.1	44.9	12.6	20.2	20.6
20-24	67.4	52.8	45.5	3.8	4.1	10.6
25-34	68.4	59.4	52.0	6.7	11.8	11.9
35-44	67.3	58.8	44.2	12.3	13.8	21.2
45-64	57.9	49.7	48.8	15.3	28.6	26.3
≥ 65	36.4	26.4	27.9	21.5	33.0	26.6
<b>FEMALE</b>						
Total <sup>3,4</sup>						
All ages ≥ 20 <sup>5</sup>	34.2	32.5	29.8	8.2	13.9	15.7
20-24	41.9	34.2	32.7	7.3	10.4	11.0
25-34	43.7	37.5	31.6	9.9	12.9	14.4
35-44	43.7	38.2	34.9	9.6	15.8	18.9
45-64	32.0	34.8	30.8	8.6	15.9	17.1
≥ 65	9.6	12.8	16.8	4.5	11.7	14.2
White						
All ages ≥ 20 <sup>5</sup>	34.5	32.4	30.0	8.5	14.6	16.3
20-24	41.9	34.4	33.3	8.0	11.4	12.5
25-34	43.4	37.1	31.6	10.3	13.7	14.7
35-44	43.9	38.1	35.6	9.9	17.0	20.2
45-64	32.7	34.7	30.6	8.8	16.4	17.4
≥ 65	9.8	13.2	17.4	4.5	11.5	14.3
Black						
All ages ≥ 20 <sup>5</sup>	32.7	34.7	30.6	5.9	10.2	11.8
20-24	44.2	34.9	32.3	2.5	5.0	2.2
25-34	47.8	42.5	34.2	6.7	8.9	11.6
35-44	42.8	41.3	36.5	7.0	9.6	12.5
45-64	25.7	38.1	34.3	6.6	11.9	14.1
≥ 65	7.1	9.2	9.4	4.5	13.3	14.1

<sup>1</sup> A current smoker has smoked at least 100 cigarettes and now smokes; includes occasional smokers.

<sup>2</sup> Final estimates. Based on data for the last 6 months of 1980.

<sup>3</sup> Base of percentage excludes persons with unknown smoking status.

<sup>4</sup> Includes all other races not shown separately.

<sup>5</sup> Age adjusted by the direct method to the 1970 civilian noninstitutionalized population using 5 age groups.

NOTE: Percentages do not add up to 100 because of "never smokers" in the survey population.

SOURCE: Data from the National Health Interview Survey, National Center for Health Statistics, 1965, 1976, and 1980, based on household interviews with a sample of the civilian noninstitutionalized population.

rally, the beginning of the decline in CHD mortality closely followed the decline in prevalence of smoking after the issuance of the first

**TABLE 7.—Change in percentage of current cigarette smokers and of those who smoke 25 or more cigarettes per day, by color, sex, and age, United States, 1965 to 1980**

Color, sex, and age	All current smokers	Smoke 25 or more cigarettes per day
White men, age 20+	-27.0	+0.7
20-24	-31.8	-9.2
25-34	-30.6	-12.1
35-44	-26.5	-2.1
45-64	-21.6	+18.2
65 and older	-37.5	+14.3
Black men, age 20+	-25.8	-12.5
20-24	-29.4	-11.1
25-34	-23.1	-24.2
35-44	-37.6	-32.1
45-64	-19.7	+22.2
65 and older	-20.6	+166.7
White women, age 20+	-13.7	+46.2
20-24	-21.2	+38.6
25-34	-27.2	+16.7
35-44	-18.9	+55.6
45-64	-7.6	+66.0
65 and older	+78.6	+257.1
Black women, age 20+	-14.0	+50.0
20-24	-28.7	unknown <sup>1</sup>
25-34	-31.2	+26.2
35-44	-19.6	+15.4 <sup>1</sup>
45-64	-31.1	+344.4 <sup>1</sup>
65 and older	+22.5	unknown <sup>1</sup>

<sup>1</sup> Figure does not meet standards of reliability or precision.  
SOURCE: National Center for Health Statistics (29).

Report of the Surgeon General on *The Health Consequences of Smoking*. The same phenomenon has been reported in other countries as well (37).

The decline for CHD mortality is occurring among adults of all age, color, and sex groups, a pattern similar to that of the reduction in the proportion of the population who are cigarette smokers. The mortality decline is steeper among younger adult age groups, which is consistent with not starting to smoke or early smoking cessation. Since 1950 for males and 1960 for females, each succeeding sex cohort has experienced a lower peak prevalence of smoking (42). The evidence of more rapid declines in mortality for persons on a higher